Operating instructions
RPM-8000-PRO

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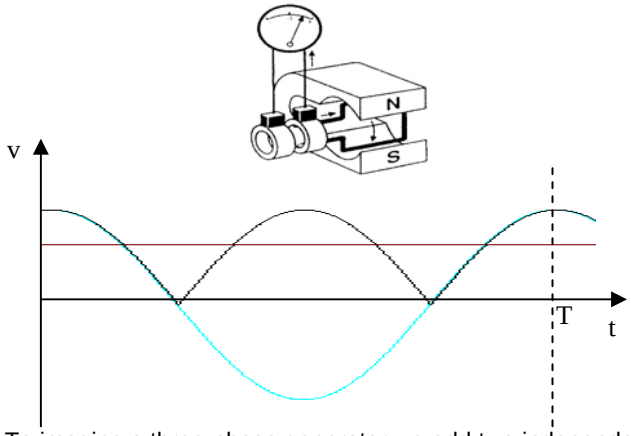
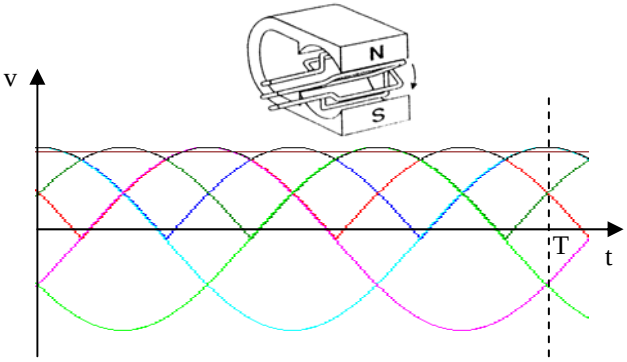
Operating principle

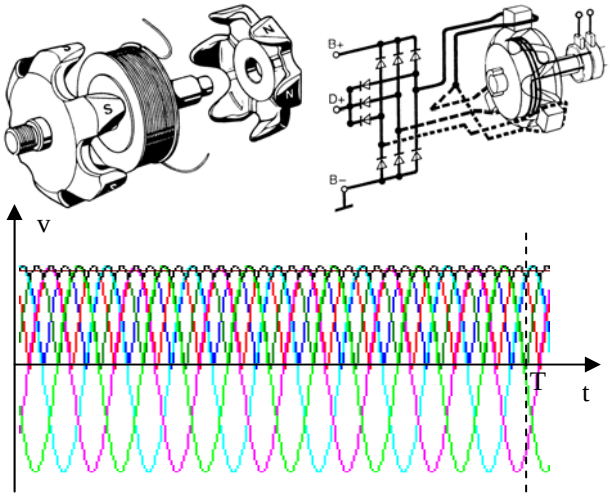
Considering the simplest physical generator with a rotating wire winding inside a magnetic field produced by two magnetic poles (one pole pair = north and south) - the output voltage is a sine wave (blue line) with one cycle per revolution. After rectification with diodes we get an alternating DC voltage with 2 pulses per revolution (black line) and a resulting average voltage (brown line).



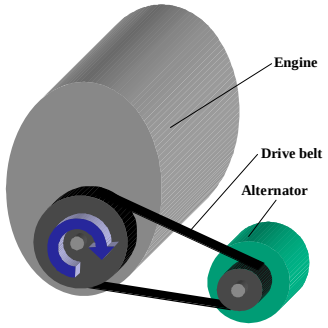
To imagine a three-phase generator we add two independent wire windings. Now we have 3 sine wave voltages which are spaced about 120° out of phase. After three-way rectification with six diodes the result is an alternating DC voltage with 6 pulses per revolution (black line) and an increased average voltage against the generator with one winding.



In practice generators for automobiles have more than two poles. In most cases here we find 12 poles (6 pole pairs) and sometimes also 16 poles (8 pole pairs). For the first one we get from every phase 6 cycles per revolution and after rectification an alternating DC voltage with 36 pulses.

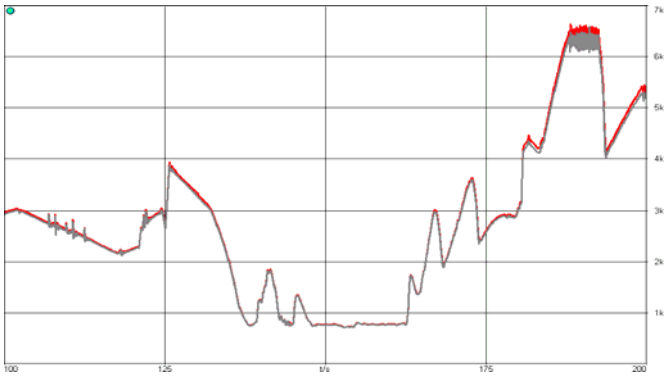


The board net voltage ripple frequency can simply calculated by multiplying the alternator RPM with the number of poles (e.g. 12*2=24) and the number of phases (3). 12*2*3 = 72



By connecting to an automotive cigarette lighter socket the measurement unit RPM-8000 PRO senses the small AC ripple of the vehicle board net DC supply voltage and generates on its outputs both a TTL digital pulse train and an analog voltage signal. These signals are “per design” linear to the alternator RPM and by the linear drive belt relationship also to the engine RPM. The scaling factor can determined by the relation between the effective diameters of the engine and the alternator pulleys.

Accuracy:
Next diagram shows a part of a test measurement of a famous German automobile manufacturer. The RPM reference signal was obtained from the car internal CAN bus, which will also used for the electronically engine management. To verify the dynamical performance, the RPM signal was provide with an additional scaling factor of 1.02 - actually both curves are congruent.



In practice the generated alternator ripple also includes electrical noise and disturbances from other electrical devices and loads connected to the vehicle supply. In petrol engine vehicles this is mainly due to the ignition system and is relatively straight-forward to eliminate. In Diesel engine vehicles however the main noise source is from the electronic injection system and, due to the spectral content of the injection signals, is very difficult to decouple from the relatively small signal of interest from the alternator. This technical background helps to explain the different accuracies of the RPM signal, which are achieved: approx. 0.5% for Petrol and approx. 1.5% for Diesel engines. **To improve the signal-to-noise ratio, additional resistive loads such as rear window heater and lights (not gas discharge lamps) should be turned on. All inductive loads such as air conditioning system, air blower, light dimmer, sliding roof and door opener should remain off! This process increases the accuracy of the output signal in every case**

General description

RPM-8000-PRO offers a discerning solution for automotive RPM measurement without an additional sensor: the practical instrument is simply connected via a standard jack to the cigarette lighter socket and the RPM is shown directly on the LCD display. You even have the choice to output the data as an analog voltage (1 Volt per 1000 rev/min) or as a digital pulse sequence, 1:1 ripple of the alternator (TTL). The smart measuring principle is based on an analysis of the ripple balance of the supply system, characteristic for all automotive alternators. The frequency (TTL) of this ripple amounts to about 100 to 120 pulses per engine rotation and therefore delivers good dynamic measuring results.

Though the frequency is proportional to the engine RPM, it also depends on the gear transmission ratio from crankshaft/alternators and on the number of alternators poles and phases. This makes the calibration of the input signal to the actual measured RPM necessary. The latest version of the RPM-8000-PRO now offers two elegant options:

- Internal calibration: The internal calibration assumes a steady engine RPM of 2000 rev/min (drive e.g. in the 2. gear and had hold 2000 RPM), which can be monitored by the automotive tachometer. By pushing the *"Cal. Int"* button and keep the button pressed until the red LED stops flashing, and is permanently illuminated.

- External calibration (option): A laser RPM *"RPM-LASER-CAL"* is needed for this option. A reflector tag is mounted on the main belt disc and scanned by laser beam. The TTL output of the laser instrument is connected via cable to the *"Ext. Cal In."* input of the RPM-8000-PRO and delivers one pulse per rotation. (don't press the "Cal Int" Button for Ext.). By comparing the pulse sequence with the measured pulse frequency, the instrument calculates automatically the relationship between ripple balance and speed. Identical displays on laser and RPM-8000-PRO signal successful calibration (also shown by luminescent LED's).

The measuring range of the analog output can be varied on demand via jumpers (e.g. to 0.5, 1.0 or 2.0 Volt per 1000 rev/min). The TTL output can also be scaled with a frequency factor of 1:8 or 1:16 – and therefore adapted to the resolution ability of attached measuring systems. For software setting purposes, the number of pulses per (e.g. 80-120) revolution is indicated by pressing the yellow TTL button, independently of the digital output divider (TTL Div). The instrument saves the calculated calibration data in non-volatile memory until the next calibration.

Functions and display:

To battery or cigarette lighter sockets - 12-42V

LCD screen
Indicates the actual speed or the number of pulses per revolution is indicated by pressing the yellow TTL button

SYNC OK LED
Lights up when RPM8000Pro is synchronized with the engine speed.

Power ON LED
Lights up when 12-42V is applied to the cigarette lighter.

TTL out (output)

Divider for digital output:
1:1 or 8:1 or 16:1

For example:
4000 Hz TTL at div. 1 position
500 Hz TTL at div. 8 position
250 Hz TTL at div. 16 position

TTL button
Switches the screen to **number of pulses per revolution**, as long as the button is pressed.

Internal calibration
When the vehicle tachometer registers a constant speed of 2000 rev/min, keep the Cal. Int. button pressed until the red LED stops flashing, and is permanently illuminated

Dig. output 0-5V TTL

Analog output 0-10V

Connection for LASER RPM tachometer
Don't press the CAL button during external calibration!!
(Self detection of EXT Cal input!)

External calibration with laser-based tachometer:

Attach a reflector tag (approximately 10 mm long) to the calibration shaft (crankshaft).

Plug the RPM-8000-PRO into the cigarette lighter socket outlet or connect directly to the battery. Make sure polarity is correct when connecting to the battery.

Start engine – turn on lights and rear window heater – turn off the air conditioning system and other inductive loads – run engine at constant no-load speed – connect TTL output from laser to *"Cal. Ext. In"* jack on the RPM-8000-PRO.

Point the laser beam at the reflector tag at an angle of about 90°. The RPM-8000-PRO is calibrated when both the laser and the RPM-8000-PRO show the same speed, the red LED stops flashing and the green LED is permanently illuminated. The calibration data is stored permanently in the device and therefore is not lost when power is turned off. The data is only overwritten when the device is recalibrated.

The ***"Cal Int."*** button should **not be pressed** while using the external calibrated process. The RPM-8000-PRO is now set to the actual speed of the shaft with reflector tag and is shown on the screen. A DC voltage of 1V per 1000 rev/min is applied to the analog output.

GB OPERATING INSTRUCTIONS

CE

Version 02/09

Laser Revolution Counter DT-10L

Item-No. 12 26 24

Intended use

This measuring equipment is an optical rev counter with a precise measuring laser for use in private and commercial fields. The measurement is carried out via reflection. Self-adhesive reflective markers are provided and can be fixed to revolving objects. The rev counter emits a red laser beam which is reflected by the reflective marker. A photo diode inside the rev counter records the reflected laser light and analyses it. Due to the precise laser beam even small objects with a large clearance of 5 to 50cm can be measured. The measured values can be read in RPM (Revolutions Per Minute) in the 5-digit-display or as an event (incremental counter).

The appliance can be operated with a 9V battery or with an optional mains supply adapter of 9V/DC output voltage. No other use is permitted. The device is to be operated solely with the stated voltages. Never try to operate the device at different voltage or with other battery types.

Any usage other than described above is not permitted and can damage the appliance. Beyond this there is the risk of injuries, e.g. to the eyes. No part of the product may be modified or rebuilt! Observe the safety instructions absolutely!

Contents

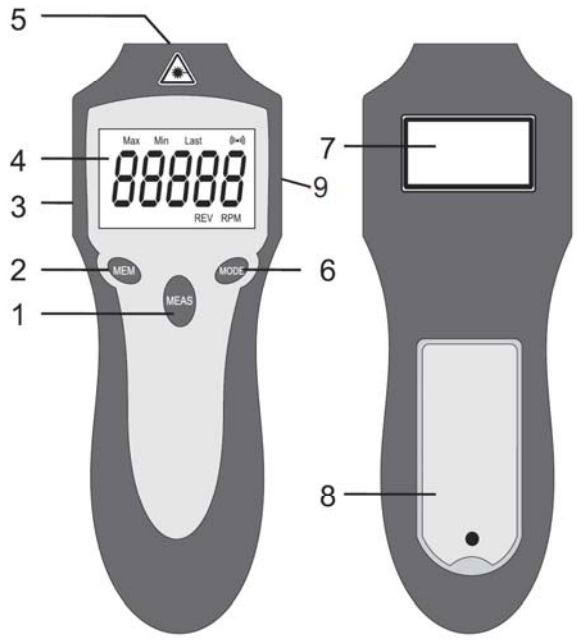
Laser Revolution Counter DT-10L

9V battery block (NEDA 1604/IEC 6F22)

3 self-adhesive reflective markers á 20cm.

Operating instructions

Description of individual parts



1 Button for measuring mode „MEAS“
2 Button for measuring memory „MEM“
3 DC-connector for the mains supply adapter
4 illuminated LC-Display
5 laser outlet
6 button to choose the measuring mode „MODE“
7 laser caution label
8 battery compartment for 9V battery block
9 TTL output via LEMO plug

Safety instructions

Please read the entire operating instructions before using the product for the first time; they contain important information regarding the correct operation.

The guarantee is rendered invalid when damage occurs as a result of non-compliance with the operating instructions! Liability for any and all consequential damage is excluded!

We do not assume any liability for material and personal damage caused by improper use or non-compliance with the safety instructions! The warranty is voided in these cases.

A triangle containing an exclamation mark indicates important information in these operating instructions which is to be observed without fail.

The „hand“ symbol is used to indicate where specific hints and information on handling should be given.

CE This device conforms to CE and meets the necessary european regulations.

Due to safety and license reasons (CE) it is not permitted to make alterations and/or changes to the electrical appliances on one's own authority.

To ensure a safe operation the user must follow the safety instructions and warning notices that are included in these operating instructions.

The product is equipped with a laser of laser class 2 according to EN 60 825-1: 1994.

CAUTION LASER RADIATION
DO NOT STARE INTO THE BEAM
CLASS 2 LASER RPODUCT
Output: <1mW
Wavelength: 635-670nm
EN 60 825-1:1994+A1:2002+A2:2001

The laser outlet is marked with the triangular laser caution label. Never look into the laser beam and never point it at people or animals. Laser radiation can cause damage to eyes or skin.

Do not point the laser beam at mirrors or other reflecting areas. Any inadvertent misdirecting of the beam may harm people or animals. Therefore only the provided self-adhesive reflective markers are to be used for measuring.

If operating devices other than the herein stated or other pro
can result in dangerous beam exposure.

If the laser caution label (7) placed on the device should not be printed in your language use the provided laser caution labels in the respective language.

Keep measuring devices and accessories out of reach of children! They are not toys.

On industrial sites the accident prevention regulations of the association of the industrial workers' society for electrical equipment and utilities must be followed.
In schools, training facilities, hobby and self-help workshops operating chargers and the accessories should be supervised by qualified trained staff.

Avoid the operation under unfavourable ambient conditions. This damages the sensitive electricity in the inside of the charger and thereby possibly leads to danger to life of the user. Unfavourable ambient conditions are:

- Excessively high humidity (> 90% rel., condensation)
- Moisture
- dust and flammable gases, vapors or solvent, petrol
- excessively high ambient temperature (> ca. +50°C)
- Strong vibrations

Do not switch the measuring instrument on immediately after it has been taken from a cold to a warm environment. Condensation that forms might destroy your device. Leave the device switched off and wait until it has reached room temperature.

Do not leave packaging material unattended. It may become a dangerous toy for children!

If you have a reason to believe that the device can no longer be operated safely, disconnect it immediately and secure it against being operated unintentionally.

It can be assumed that safe operation is no longer possible if:

- the device is visibly damaged,
- the device no longer works and
- the unit was stored under unfavourable conditions for a long period of time or
- if it has been subjected to considerable stress in transit.

RPM-Laser-CAL general function-2.2:

Installing/Replacing batteries

A 9V battery block (e.g. type IEC 6F22) is required for operation.

To insert/replace the battery, proceed as follows:
Unscrew the battery compartment lid on the back (8) and remove the lid.
Connect the new battery with the correct polarity to the battery clip and close the battery compartment in reverse order.

It is necessary to change the battery when the display can no longer be read properly or when the appliance cannot be switched on anymore.

In order to avoid damage to the appliance from leaking batteries, remove the battery from the appliance when you do not use the appliance for a long time. For the same reason empty batteries have to be removed immediately.

Do not leave batteries lying around carelessly. They might be swallowed by children or pets. If swallowed, consult a doctor immediately.

Batteries must not be charged, shorted or thrown into fire. There is a danger of explosion.

Leaking or damaged batteries may cause alkali burns if they come in contact with the skin. Use apropriate protective gloves in such case.

A suitable Alkaline battery can be order with the following item number:
Item no. 65 25 09 (please order one).
Try to use only Alkaline batteries, since they are powerful and durable.

Alternatively the measuring device can also be operated with an optional mains supply adapter via the connector on the side (3) . The DC-plug of the mains adapter has to have the following characteristics:

Measurements (Inside / outside Ø): 2.1 x 5.5 mm
Polarity: Inside positive pole, outside negative pole.
Output voltage: 9 V/DC, stabilized

Initial Operation

By pressing the button „MEAS" (1) the rev counter is turned on and the laser is activated. The measuring process starts and the device works as long as the button is held down.
Always point the measuring device with its laser outlet (5) away from the body and do not look directly into the outlet during the measuring.

measuring

a) Measuring preparation

- Cut off a piece of about 12mm length from the provided self-adhesive reflective foil. The surface has to be dry and free of dust and grease.
- attach the piece to the spindle or similar to be measured

Revolving parts have to come to a halt before the reflective markers can be attached; secure the machine against incidental activation!

- Ensure a good contrast (light-dark); if necessary paint the objects to be measured black (in the area of the rotating reflective marker). The non-reflecting part has always to be bigger than the reflective marker.

b) Measuring of Revolutions (RPM-mode)

- Press the measuring button (1) once briefly to turn on the display. The display has to show „RPM". If not, you can switch the measuring function with the MODE-button (6).
- Press the measuring button (1) and hold it down. The display shows „RPM" and the laser is active.
- Direct the laser beam with a maximum angle of +/- 45° to the reflective marker. The distance between rev counter and marker can be between 5 to 50 cm. When correctly reflected the display show a target symbol ((•)) in the upper right corner, which flashes in time with the measuring or remains visible at higher revolution speed.

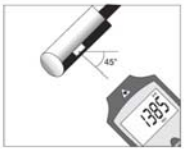
- The disply (4) shows the revolutions in „RPM" = Revolutions per minute. If „OL" is displayed the measuring range has been exceeded.
- Measuring failures can occur on very slow rotating objects; this can be prevented by attaching more reflective markers evenly around the object. The measuring result has to be divided by the number of reflective markers.
- After measuring just release the measuring button „MEAS" (1). The appliance turns off after ca. 10s automatically.
- A new measuring always starts with 0,0.

c) Measuring with counter (REV-mode)

The counter can be used to count items on conveyors etc.. With this each recording is counted consecutively as an event.

When using the counter, the laser has to be directed to a black or non-reflective area between the objects in order to ensure a reliable record of the running events. Avoid diffused light from other light sources.

- Press the measuring button (1) once briefly to turn on the display. The display has to show „REV". If not, you can switch the measuring function with the MODE-button (6).
- Press the measuring button (1) and hold it down. The display shows „REV" and the laser is active.
- Direct the laser beam with a maximum angle of +/- 45° to the object to be measured. The distance between rev counter and marker can be between 5 to 50 cm. When correctly reflected the display show a target symbol ((•)) in the upper right corner, which flashes in time with the measuring or remains visible at higher throughput speed.



- The display (4) shows the number of recorded events. If „OL" is displayed the measuring range has been exceeded.
- After measuring just release the measuring button „MEAS" (1). The appliance turns of after ca. 10s automatically.
- A new measuring always starts with 0.

d) Reading out the measurment memory

The rev counter has a memory for the measuring values where the smalles value (Min), the most recent value (Last) and the highest value are stored. To read out the memory, proceed as follows:

- Press the button „MEM" (2) briefly. The display turns on.
- Every further pressing switches to the next measuring memory value.
- The following displays are possible:
  RPM-Mode: Max as maximum value, Min as minimum value and Last as the recent value.
  REV-Mode: The most recent value is displayed.
- The measuring results are kept in memory until the next measuring.

Disposal

Electronic products are a raw material and do not belong in household waste. When the device has reached the end of its service life, dispose of it in accordance with the current statutory regulations at the communal collection points. Disposal in the domestic waste is not permitted.

Disposal of used batteries/rechargeables!

You, as end user are legal obliged **(Battery Regulation)** to return all used batteries and rechargeable batteries; **disposal of them in domestic waste is not permitted!**

Contaminated batteries/rechargeable batteries are labelled with these symbols to indicate that disposal in domestic waste is forbidden. The symbols for dangerous heavy metal constituents are: **Cd** = Cadmium, **Hg** = Mercury, **Pb** = Lead. You can return your used batteries/rechargeable batteries free of charge to the official collection points of your community, in our stores, or everywhere where batteries or rechargeable batteries are sold. You thus fulfil your statutory obligations and contribute to the protection of the environment.

Technical data

Operating voltage	9 V/DC battery block or 9 V/DC stabilised via external DC-connector
Power input	appr. 45mA
Display	5-digit LCD
Display reload	1 s
Measuring range	RPM: 2 - 99,999 RPM REV: 1 - 99 999
Display resolution RPM	0,1 (2 - 999.9 RPM)/1 (>1000 RPM)
Accuracy	± (0.05% + 1 Digit)
Measuring time	0.5 s > 120 RPM
Measuring distance	5 - 50 cm
Automatic cut-off	without measuring after appr. 10s
Operating conditions	0 to 50°C/10 to 90 %rF (not condensing)
Weight	ca. 151g
Dimensions (LxWxH)	160 x 58 x 39 mm

Internal calibration using the Cal button:

When a constant speed of 2000 rev/min is registered by the vehicle tachometer, press the Cal. Int. button until the red LED stops flashing, and remains constantly illuminated.

Internal calibration requires that the engine is running at a speed of 2000 rev/min, as shown on the tachometer in the vehicle (ideally calibration should be carried out when the vehicle is being driven, that is, moving). When this speed is reached, press and hold *"Cal. Int."* button until the red LED stops flashing and is permanently illuminated. Calibration is than completed and the calibration value is stored permanently in the device even after power is turned off. The calibration value is only deleted if the *"Cal. Int."* button is pressed again: the old calibration value is then replaced by the new value. (The same applies to external calibration). The actual engine speed appears on the screen and the analog output returns 1V per 1000 rev/min.
During calibration and during the entire test you should turn on all resistive loads such as lights and rear window heater; and turn off all inductive loads such as the air conditioning system, sliding roof, power windows and ventilation. You shouldn't use an external laser tachometer during internal calibration!!.

Starting up the RPM 8000 PRO revolution counter:

The RPM-8000-PRO is designed to operate at 12 - 42V DC. You can use our battery adaptor to connect directly to battery terminals.

Caution!!!!!

Red = Plus ++
Black = Minus --
A polarity mismatch will inevitably cause damage to the device and voids the warranty!!

When connecting to the vehicle electrical distribution system instead of the cigarette-lighter socket, always make sure the polarity of the connection cable is correct. If you have contact problems with some makes of cigarette lighters you should use an adapter cable (from a different connector type to a standard socket) to avoid inadvertently reversing the connection terminals.

To improve the signal-to-noise ratio, additional resistive loads such as rear window heater and lights (not gas discharge lamps) should be turned on. All inductive loads such as air conditioning system, air blower, light dimmer, sliding roof and door opener should remain off! This process increases the accuracy of the output signal in every case.

Start the engine, connect the coiled cable to the "Board Net" socket and plug the other end into the cigarette-lighter socket in the vehicle. Make sure that the red "Power" LED on the RPM-8000PRO is illuminated.

After a short delay the device will detect the engine speed signal. Successful synchronization is signaled by the green "O.K." LED on the RPM-8000PRO. The device is now in the ready state and all measuring signals are available at the output. If synchronization has not taken place after a few seconds, this means that strong noise signals from vehicle loads have been superimposed on the residual ripple from the vehicle electrical distribution system. In which case briefly press the accelerator and synchronization will be achieved after returning to no-load speed.

You can now carry out the first tests by increasing and reducing the engine speed in the idling state and by monitoring the LCD display and the voltage at the analog output. If the voltage tracks the engine speed synchronously, the device is functioning properly on your vehicle.

Trouble shooting:

- The use of cigarette-lighter sockets in the rear seating area or in the car trunk in some vehicles can cause additional interference noise to be injected into the long line routes. You should therefore repeat the test at the socket on the dashboard or on the driver's console.
- A loss of synchronization may occur when the engine speed drops. In this case the vehicle electrical supply briefly switches to battery-backup mode, as the high Faraday capacity of the battery is not able to decay quickly enough. To eliminate this effect, switch on additional resistive loads (lights, window heater, etc.).
- Some diesel engines in higher-class cars are equipped with overrunning alternators. In cases of extremely high decelerations this may cause a short-time rotational speed difference between engine and alternator. This is important to know, because the RPM-8000-PRO actually measures the number of revolutions per minute of the alternator.
- If the RPM-8000-PRO is operated from the vehicle electrical distribution system while the engine is off and the ignition is on, it may synchronize with arbitrary noise signals from the vehicle electrical distribution system, the reference signal from the residual ripple is not available. In this case the green "O.K." LED is energized before the engine is started, and the system must be "reset" by removing the connector from the cigarette-lighter socket for a short period. The same applies if the engine is stopped and the green "O.K." LED does not go out.
- On some luxury cars the RPM-8000-PRO may not work when plugged into the cigarette lighter socket. This is caused by interference noise induced in the cable looms. The interference noise is generated by the considerable amount of electronic hardware in these models and is within the synchronization spectrum of our RPM-8000-PRO. To avoid this problem, connect the device via the supplied adapter cable to the battery or to a plus terminal nearest the battery. Make sure the polarity of the adapter cable is correct

Should none of the above measures prove successful, please contact us at: Mr. Plaksin plaksin@kmt-gmbh.com

Technical details:

Supply voltage	12-42 V
Power consumption	80 mA maximum
Analog output:	adjustable (Plug-in bride) 0.5 V, 1 V or 2 V per 1000 rev/min (Standard 1V)
	max. delay 70 ms
	accuracy > +/- 0.5% for petrol and +/- 1.5% for Diesel engines.
	output impedance 2 ohm 10 mA
Digital output:	frequency range approximately 500 Hz – 10 kHz
	set with frequency divider 1/1; 1/8; 1/16
	TTL level 0 and 4 V
	output impedance 130 ohm
	Max. delay 0.1 – 2 ms
	jitter 0.1 – 1 %
Synchronization frequency range	800 Hz -2 kHz
Synchronization time	1 – 2 seconds
Calibration:	internal: based on 2000 rev/min indicated on tachometer in vehicle.
	external: with laser (RPM-LASER-CAL) and reflector tag on crankshaft.
Displays:	LCD screen 4 ½ position for engine speed-frequency or conversion factor frequency/engine speed

LED red	Power
LED green	Synchronization OK
LED yellow	Number of pulses per revolution
LED red	Calibration OK

Rotary switch:	frequency divider 1/1, 1/8 or 1/16 (TTL Div) for TTL out
Red button:	start internal calibration
Yellow button:	show the number of pulses per revolution is indicated by pressing the yellow TTL button, independently of the digital output divider (TTL Div).
Connectors:	BNC for TTL output
	BNC for analog output
	BNC for external calibration input
	3 pole Tuchel for connecting to vehicle electrical distribution system through cable
	with connector for cigarette lighter
Dimensions:	150 x 75 x 40mm
Weight:	450g without connection cable
Material:	anodized aluminum
Operating temperature:	-5°C to +70°C
Storage temperature:	-20 to +80°C
Humidity:	20 – 80%
Vibrations:	5g military standard 810C curve C
	shock in all directions 100 g

KMT - Kraus Messtechnik GmbH

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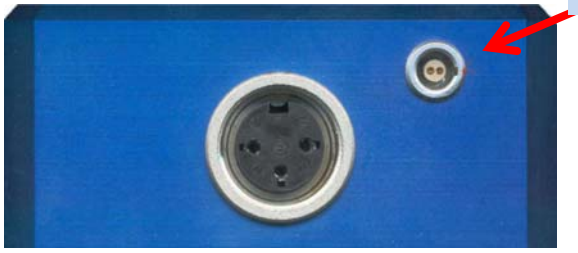
RPM8000PRO

Test signal output

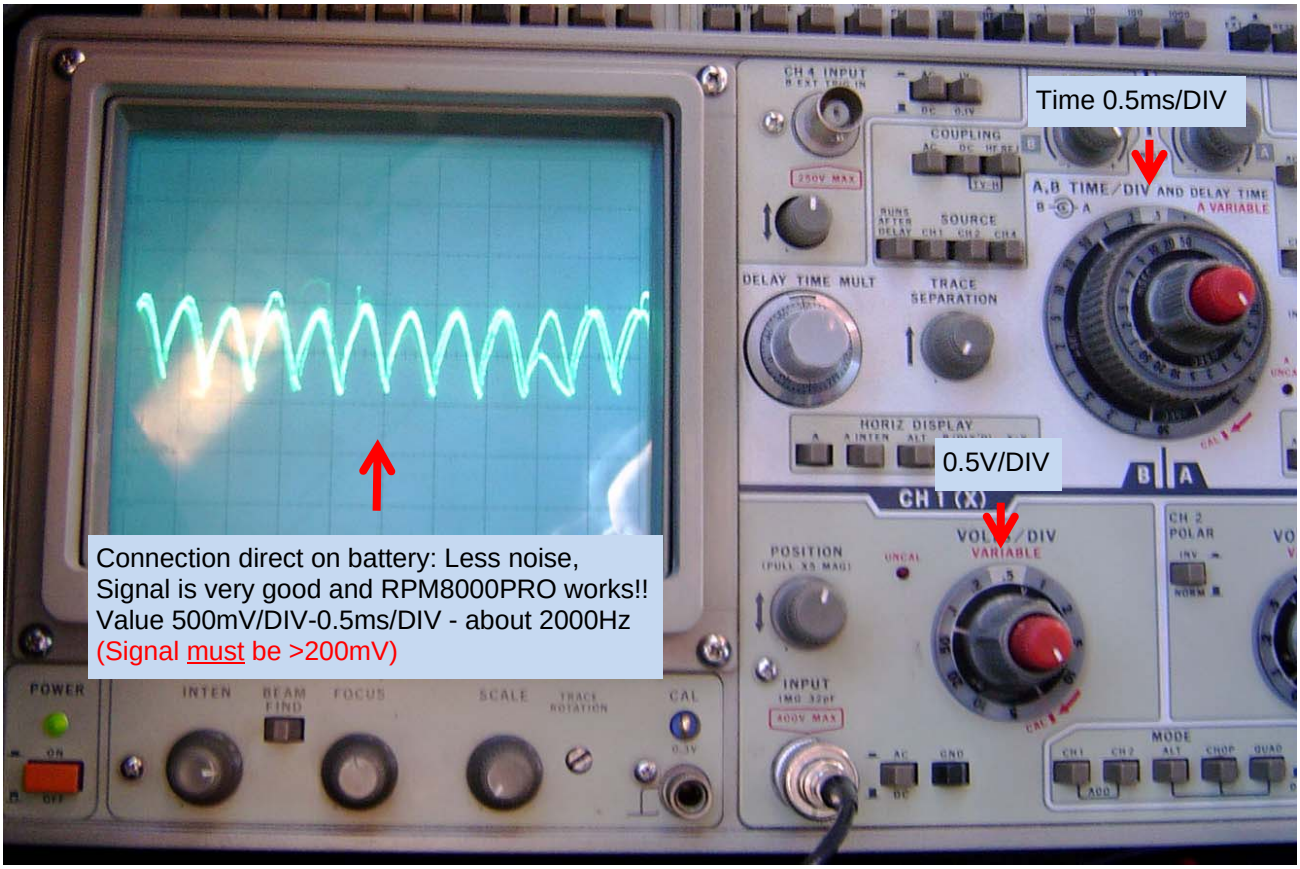
Connection:

Test cable (Mini-Lemo 2-pol. to BNC)
You can use the same cable what delivered with LASER-CAL

Test Point



Signal measure at 1300 RPM - Direct connection on car Battery via adaptor



Signal measure at 1300 RPM - connection on car cigarette lighter